

REMARKS

By this amendment, claims 1-8 and 13-20 have been revised to place this application in condition for allowance. Currently, claims 1-8 and 13-20 are before the Examiner for consideration on their merits.

First, the claims have been revised to remove the language concerning a plastic processing and because of this, the rejection based on 35 USC §112, first paragraph is overcome and should be withdrawn.

Second, the claims are amended to define a particular yield strength of more than 815 MPa and support for this can be found in Table 2, example 13 of the present specification.

Turning now to the prior art rejection, claims 1-4 and 13-16 stand newly rejected under 35 USC §103 based on United States Patent No. 5,232,520 to (US '520). Claims 5-8 and 17-20 stand newly rejected under 35 USC §103 based on JP 11-310823 (JP '823).

Applicants respectfully traverse the rejection and the traverse is set out below under the heading of the applied prior art.

US '520

The object of the invention of US '520 is recited in col. 3, lines 26-31 as follows:

Accordingly, an object of the present invention is to provide a high-strength martensitic stainless steel which has a proof strength of 80 to 110 kgf/mm² or greater and which is superior in resistance to corrosion and erosion, fatigue properties in sea water and weldability, as well as method for producing steel.

Also instructive in considering the teachings of US '520 is claims 1 and 2, which define a high strength martensitic steel and claims 5 and 6, which define a method of making the high strength martensitic steel as follows:

Claim 1. A high strength martensitic stainless steel having superior fatigue properties when used in a corrosive or erosive environment, said stainless steel possessing a proof strength of 80 to 110 kgf/mm² and having a chemical composition consisting essentially of: 0.005 to 0.04 wt % of C, not more than 1.0 wt % of Si, not more than 2.0 wt % of Mn, 12.0 to 17.0 wt % of Cr, 3.0 to 6.0 wt % of Ni, 0.1 to 1.5 wt % of Mo, 0.02 to 0.5 wt % of V, 0.005 to 0.02 wt % of N, and not more than 0.01 wt % of Al, wherein the ratio of area occupied by non-metallic inclusions to the area of the cross-section of said steel cannot exceed 0.01%; whereby the number of loading cycles till rupture is greater than 10⁵ and the balance substantially Fe and incidental inclusions, the contents of C, Si, Mn, Cr, Ni, Mo, V, N and Al being determined such that a Ni equivalent Nieq given by the following formula (1) ranges between 10.5 and 12.9 wt %:

$$\text{Nieq} = [\text{Ni}] + [\text{Mn}] + 0.5[\text{Cr}] + 0.3[\text{Si}] + [\text{Mo}] \quad (1)$$

where, [Ni], [Mn], [Cr], [Si] and [Mo] respectively represent the contents of Ni, Mn, Cr, Si, and Mo in weight %, respectively.

Claim 2 requires the presence of one or both of Cu and Nb

Claim 5. A method of producing a high strength martensitic stainless steel of claim 1 possessing a proof strength of 80 to 110 kgf/mm² and having superior fatigue properties when used in a corrosive or erosive environment, comprising the steps of: preparing a steel having a chemical composition consisting essentially of: 0.005 to 0.04 wt % of C, not more than 1.0 wt % of Si, not more than 2.0 wt % of Mn, 12.0 to 17.0 wt % of Cr, 3.0 to 6.0 wt % of Ni, 0.1 to 1.5 wt % of Mo, 0.02 to 0.5 wt % of V, 0.005 to 0.02 wt % of N, and not more than 0.01 wt % of Al, and the balance substantially Fe and incidental inclusions, the contents of C, Si, Mn, Cr, Ni, Mo, V, N, and Al being determined such that an Ni equivalent Nieq given by the following formula (1) ranges between 10.5 and 12.9 wt %:

$$\text{Nieq} = [\text{Ni}] + [\text{Mn}] + 0.5[\text{Cr}] + 0.3[\text{Si}] + [\text{Mo}] \quad (1)$$

where, [Ni], [Mn], [Cr], [Si] and [Mo] respectively represent the contents of Ni, Mn, Cr, Si, and Mo in weight %, respectively; subjecting said steel to a heating to a temperature of 1250 °C. at the maximum; subjecting the heated steel to a hot rolling at a rolling finish temperature of not less than 800 °C; cooling the hot-rolled steel to a temperature not higher than 100 °C at a cooling rate which is not smaller than the cooling rate V_c (°C/min)

which is computed in accordance with the following formula (2); and subjecting the cooled steel to a tempering or a quenching-tempering treatment:

$$V_c = 2 \times [Ni] + 100([C] + [N]) \quad (2)$$

where, [Ni], [C] and [N] respectively represent contents of Ni, V, N and Al in said steel.

Claim 6 is similar to claim 5 but dependent on claim 2.

In addition, US '520 involves the inventive philosophy of attaining a higher strength of martensitic stainless steels and have found that, in order to attain a higher strength without reducing corrosion resistance, it is most important to prevent precipitation of coarse carbides at the grain boundaries.

US '520 also mentions in col. 8, lines 34-48 as follows:

According to the invention, the range of the tempering temperature which enables the tempered steel to exhibit a proof strength of 80 to 110 kgf/mm² depends on the composition of the steel. When Cu and Nb are not added, the tempering temperature preferably ranges between 400 °C and 500 °C. Namely, when the temperature is below 400 °C, it is impossible to obtain a proof strength of 80 kgf/mm² or greater because such a low tempering temperature cannot cause precipitation of fine carbides. On the other hand, tempering at high temperatures exceeding 500 °C causes precipitation of coarse carbides, with the result being that corrosion resistance is impaired due to precipitation of coarse carbides. When Cu and Nb are added, the tempering temperature may be raised to 650 °C.

The above clearly indicates that the intention that the tempering treatment at 400 °C or more is applied to cause fine carbides to precipitate to thereby strengthen the steel. Namely, this represents the inventive philosophy that the production method of US '520 is to suppress the precipitation of carbides as least as possible during the stage of cooling down from austenite territory, while allowing the precipitation strengthening to be exhibited during the tempering stage.

In the rejection, the Examiner alleges that the claimed invention involves similarities in that the chemical composition as claimed is overlapped by US '520. That is, the Examiner states:

With respect to the hardness range of 30-45 HRC and "the amount of carbides in grain boundaries of the prior austenite is not more than 0.13 vol.%" in claims 3-4, the Examiner notes that US '520 discloses a substantially similar composition in the range of 400-500 °C; and hot rolling at 1250 °C following by quenching. Therefore, a hardness in the range of 30-45 HRC and "the amount of carbides in grain boundaries of the prior austenite is not more than 0.13 vol. % would be expected"

However, while US '520 involves the inventive philosophy of suppressing the precipitation of coarse carbides as explained above, it is apparent that prior to tempering treatment, the steel has low strength because the tempering is performed at not less than 400 °C so as to cause fine carbides to precipitate to thereby strengthen the steel. That is, it is apparent that prior to the tempering treatment, the steel of US '520 has a proof strength of less than 80 kgf/mm² (less than 784.5 MPa) so that it is evident that US '520 is different from the invention as is now claimed.

In addition, the claimed invention has been amended such that the amount of carbides precipitated along the grain boundaries was changed from 0.5 to 0.13 vol.% or less. Support for this amendment can be found in Table 2, No. 7 of the specification and this can be achieved by as-quenched condition or tempering at 250 °C or less.

In other words, the amended upper limit of the amount of grain boundaries of 0.13 vol.% or less is achieved only by tempering at 250 °C or without tempering, and the upper limit will never be achieved at 400 °C, which the original specification defines as the maximum temperature in order to restrict the amount of grain boundary carbides

to 0.5 vol.% or less. Put another way, Applicants are arguing that if an carbide amount of 0.5vol.% is associated with a 400 °C tempering temperature, and the claims require an upper limit of 0.13 vol.%, which is obtained at a 250 °C tempering temperature, one of skill in the art would not expect or assume that the upper limit of the claims is present in US '520, which uses a much higher tempering temperature. The showing in the specification is sufficient evidence to rebut the assumption that the claimed upper limit would be present in US '520. Accordingly, after amendment such that the upper limit of intergranular carbides is specifically restricted, it is hardly probable that the microstructural features of the claimed invention can be realized by the production method of US '520.

In addition, while US '520 is the invention that intends to strengthen the steel by precipitating carbides during tempering as mentioned above, the claimed invention intends to suppress the precipitation of carbides as least as possible. Thus, US '520 teaches away from the invention in this regard. This being the case, the claimed invention intends to suppress carbide precipitation to the least and there is no reason that US '520 can render claims 1-4 and 13-16 obvious.

To recap, the Examiner cannot say that the features now found in claims 1-4 and 13-16 are present. That is, the yield strength limitation is not found in US '520 nor is the carbide volume percent present. The latter limitation is simply not present because US '520 wants carbide precipitation and practices a process that promotes such whereas the present invention seeks to limit carbide precipitation and practices a different process in this regard.

JP '823

The gist of JP '823 can be found in paragraph [0005] as stated below:

The invention relates to a method for producing a martensitic stainless steel tube excellent in low temperature toughness in which the chemical composition of the steel comprises C: 0.10-0.18%, Si: 0.5% or less, Mn: 0.1-1.5%, P: 0.02% or less, S: 0.01% or less, Cr: 12-14%, Ni: 1-3%, Al: 0.3% or less, N: 0.001-0.08%, and optionally one or more elements selected from a group consisting of Mo: 0.5% or less, Cu: 1.5% or less, Ti: 0.001-0.005% and Ca: 0.001-0.01%, the balance being Fe and unavoidable impurities, the method comprising the steps of:

tube making by a hot working process;

if necessary, heating the tube thus obtained to a temperature in the range of not less than A_{c3} point to not more than 950 °C, followed by cooling down to ambient temperature at a rate of not lower than that of air cooling;

heating the tube to a temperature in the range of not less than A_{c1} point to more not more than the A_{c3} point, followed by cooling to ambient temperature; and

subsequently tempering the tube at a temperature of not more than the A_{c1} point.

In the rejection, the Examiner alleges that claims 5-8 and 17-20 are obvious over JP '823 since the two inventions are similar in that JP '823 overlaps the claimed composition and the processing employed in JP '823 is similar to that employed in the invention.

With respect to the hardness range of 30-45 HRC and "the amount of carbides in grain boundaries of the prior austenite is not more than 0.13 vol.%" in claims 7 and 8, the Examiner notes that JP '823 discloses a substantially similar composition in addition to hot rolling at the Ac_3 , followed by cooling at a rate at least equal to air velocity followed by tempering at a temperature not higher than Ac_1 point. Therefore, a hardness in the range of 30-45 HRC and "the amount of carbides in grain boundaries of the prior austenite is not more than 0.13 vol.%" would be expected.

Applicants submit that the position that the hardness range and amount of carbides limitation are inherently present in JP '823 is in error.

The process of JP '823 comprises the steps of:

- 1) forming a tube by hot rolling;
- 2) (if necessary) heating up the tube to a temperature region between Ac_3 point and 950 °C and successively cooled down to a room temperature at a rate of not less than a cooling rate of air cooling;
- 3) heating up the tube to a temperature between the Ac_1 point and the Ac_3 point and successively cooled down to room temperature;
- 4) tempering at a temperature of not more than Ac_1 point.

The claimed invention is premised on suppressing precipitation of carbides along the grain boundaries of prior austenite, so that as-quenched condition as being subjected to rapid cooling or air cooling from austenite territory is based, or if any tempering, the tempering at the temperature that inhibits carbides from precipitating along grain boundaries is based.

In the steps of JP '823, heating to a temperature in the dual phase territory is included as part of step 3 above. Therefore, in the process of making of JP '823, even if the precipitation amount of intergranular carbides should be suppressed after completion of steps (1) and (2) above, reheating in the step (3) should be presumably allow part of the carbon to form carbides. Here, part of it may solution in austenite but there is no restriction in cooling subsequent to the heating step (3) so it is reasonable to consider that the carbides would grow in step (3) as compared to the case after completion of steps (1) and (2).

Least of all, JP '823 entails tempering in step (4). This tempering is nothing more than an ordinary one and the Examples shown in Table 1 of JP 823, including comparative examples, are tempered at 500 °C or more. Since JP '823 neither describes nor implies that tempering shall be performed at a temperature of 400 °C or less as described in the present specification, there is no legitimate basis for the Examiner to assume that the limitations missing in JP '823 are somehow present.

Put another way, the processing of JP '823 is not similar to that employed by the invention to obtain the claimed features and because of this, the Examiner cannot assume that the claimed features that are admitted to be missing in JP '823 are present.

Further, the claimed invention defines a hardness of HRC 30 or more in order to ensure the resistance to corrosion/erosion under oil well environment, while JP '823 is silent about HRC hardness. Moreover, the steel disclosed in JP '823 is low in strength so

that the claimed hardness would not be inherently present. This is another reason why JP '823 cannot be used to reject claims 5-8 and 17-20 under 35 USC §103.

In addition, the claimed invention has the feature that the amount of carbides precipitated along the grain boundaries is now 0.13 vol.% or less, which is found in No. 7 of Table 2 of the instant specification and achieved in the as-quenched condition or by tempering at 250 °C or less. The upper limit of the amount of grain boundary carbides of 0.13 vol.% is achieved only by tempering at 250 °C or without tempering and the upper limit would never be achieved by tempering at 400 °C, which the original specification teaches as the maximum temperature to obtain an upper limit of 0.5 vol.% or less. Accordingly, with the upper limit of grain boundary volume particularly limited to 0.5 vol.%, it is hardly probable that the microstructural feature of the invention would be present in the method of JP '823, which is fundamentally different from that employed to obtain the invention.

To summarize, the processing of JP '823 is not similar enough to the inventive one to permit the Examiner to say that the features missing in JP '823 are inherently present and therefore claims 5-8 and 17-20 are patentable over this reference and the rejection should be withdrawn.

Summary

The rejection based on US '520 is improper for the simple reasons that the limitations concerning the yield strength and carbide volume percent cannot be assumed to be present since the manner in which the alloy is made in US '520 is

entirely different from that of the invention and this means that the position of inherency with respect to the missing limitations is not correct.

The rejection based on JP '823 is not valid since this reference does not teach a processing that is similar enough to that employed by the invention to permit the Examiner to assume that the limitations missing in JP '823 are inherently present.

In light of this response, the Examiner is respectfully requested to examine this application in light of this amendment, and pass claims 1-8 and 13-20 onto issuance.

If the Examiner believes that an interview with Applicants' attorney would be helpful in expediting prosecution of this application, the Examiner is respectfully requested to telephone the undersigned at 202-835-1753.

Again, reconsideration and allowance of this application is respectfully requested.

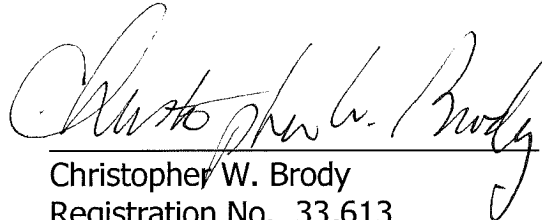
The above constitutes a complete response to all issues raised in the outstanding Office Action.

A petition for a two month extension of time is made. Please charge the fee of \$490.00 to Deposit Account No. 50-1088.

Please charge any fee deficiency or credit any overpayment to Deposit Account

No. 50-1088.

Respectfully submitted,
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